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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/372,636	08/11/1999	WOLFGANG HORNSCHEMEYER	364/56	1684

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EXAMINER	
KERNS, KEVIN P	
ART UNIT	PAPER NUMBER
1725	

DATE MAILED: 01/23/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

SN

Office Action Summary	Application No.	Applicant(s)	
	09/372,636	HORNSCHEMEYER ET AL.	
	Examiner	Art Unit	
	Kevin P. Kerns	1725	

-- Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 December 2001*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7,9-12,14 and 15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,9-12,14 and 15* is/are rejected.

7)☒ Claim(s) *1* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Objections

1. Claim 1 is objected to because of the following informalities: the word "of" should be added after "areas" in the last line of the claim (as described in the prior office action of June 6, 2001). Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1, 6, 7, and 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grove et al. (US 5,927,378) in view of Hargassner et al. (US 5,117,895).

Grove et al. disclose a continuous casting mold assembly (funnel-shaped with billet-entrance side wider than billet-exit side) in which molten metal is shaped (formed) and cooled within the casting space, further containing a selective cooling structure to accommodate heat transfer inequality due to circulation patterns, which lead to mold deterioration, particularly in the meniscus region of the mold assembly (abstract; column 1, lines 60-63; column 2, lines 4-30; column 3, lines 12-27; and Figures 2 and 3). The mold assembly has a plurality of cooling slots (grooves), in which the area around the meniscus (thermally stressed area) contain slots machined to be deeper to produce an enhanced cooling effect at the area proximate to the meniscus, while producing a diminished cooling effect to other portions of the assembly (column 3, lines 28-67; column 4, lines 1-19; and Figures 2 and 3). The width, length, spacings relative to transition region III (stressed area), and/or depths of the slots (see slots 1-19 in Figure 2), as well as the residual thickness parameters would be varied (column 4, lines 20-53; and Figures 2 and 3). The variable wall thickness in the meniscus region (thermally stressed area of the broad-side wall) is reduced on the order of a few millimeters

(column 4, lines 20-53; and Figures 2 and 3). Grove et al. do not specifically teach a surface-related heat flow in the more stressed area of the bath surface that is 5-40% (or 10-20%) greater than in the other areas of the bath surface.

However, Hargassner et al. teach a variable heat transmission coefficient (alpha) between the internal plate and the coolant with values ranging between 20 and 70 kW/m^2K, preferably between 25 and 50 kW/m^2K (column 1, lines 51-59). The heat transmission coefficient is dependent on the coolant flow velocity and the width of the coolant ribs (column 3, lines 36-45 and 66-68; column 4, lines 1-17 and 55-61; the table in column 4; and Figures 5-8). These variables are optimized for the purpose of producing effective cooling of the internal casting mold plates (column 1, lines 37-50). One of ordinary skill in the art would have recognized the optimum values of coolant flow velocity would directly related to controlling the heat transmission coefficient ranging between 20 and 70 kW/m^2K (ranging up to a factor of 3.5), which would entirely include the variations of 5-40% disclosed herein. Discovery of optimum values of resulting effective variables in a known process is within the level of ordinary skill in the art. In re Boesch and Slaney, 205 USPQ 215 (1980).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the liquid-cooled continuous casting mold assembly of Grove et al. by providing the range of values of heat transmission coefficients, channel widths, and flow velocities (Figures 5 and 8) of Hargassner et al. to calculate the surface-related heat flow for improving cooling efficiency of the mold plates (Hargassner et al.; column 1, lines 37-50).

6. Claims 1 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Villanueva et al. (US 5,797,444) in view of Hargassner et al. (US 5,117,895).

Villanueva et al. disclose an ingot mold (form-giving die of high heat conductivity) for continuous casting of metals in which its cooling-side surface has depressions, or cooling-optimized areas to constitute a region having elevated heat transfer coefficients (abstract; column 2, lines 3-8 and 20-28; and Figures 1 and 2). These regions of enhanced heat transfer, i.e. rate of heat flow, are generally located over the area of the mold where optimized heat dissipation is desired, or relative to the other areas of the mold (column 1, lines 14-16 and 24-26; and column 2, lines 3-5, 20-24, 35-37, and 44-46). The cross-sectional area at the casting pour-in side is larger than that of the billet exit side (abstract; column 1, lines 5-10; and Figures 3, 4, and 8). Villanueva et al. do not specifically teach a surface-related heat flow in the more stressed area of the bath surface that is 5-40% (or 10-20%) greater than in the other areas of the bath surface.

However, Hargassner et al. teach a variable heat transmission coefficient (alpha) between the internal plate and the coolant with values ranging between 20 and 70 kW/m^2K, preferably between 25 and 50 kW/m^2K (column 1, lines 51-59). The heat transmission coefficient is dependent on the coolant flow velocity and the width of the coolant ribs (column 3, lines 36-45 and 66-68; column 4, lines 1-17 and 55-61; the table in column 4; and Figures 5-8). These variables are optimized for the purpose of producing effective cooling of the internal casting mold plates (column 1, lines 37-50). One of ordinary skill in the art would have recognized the optimum values of coolant

flow velocity would directly related to controlling the heat transmission coefficient ranging between 20 and 70 kW/m^2K (ranging up to a factor of 3.5), which would entirely include the variations of 5-40% disclosed herein. Discovery of optimum values of resulting effective variables in a known process is within the level of ordinary skill in the art. In re Boesch and Slaney, 205 USPQ 215 (1980).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the cooled ingot mold of Villanueva et al. by providing the range of values of heat transmission coefficients, channel widths, and flow velocities (Figures 5 and 8) of Hargassner et al. to calculate the surface-related heat flow for improving cooling efficiency of the mold plates (Hargassner et al.; column 1, lines 37-50).

7. Claims 1-5 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stagge et al. (WO97/43063) in view of Hargassner et al. (US 5,117,895). Note: for the Stagge et al. reference, page numbers and lines herein refer to the English translation of this German reference (provided in the prior office action of June 6, 2001). See the prior office action for the corresponding German pages/lines, if necessary.

Stagge et al. teach a liquid-cooled chill mold (casting die) with a form-giving casting die body (page 6, lines 2-8; and Figure 1), which is made of a material of high-heat conductivity, namely copper (page 3, lines 3-12; page 6, lines 17-19; and Figure 3). The cooling-surface side of the chill mold, comprised of a cooling zone with multiple cooling channels for greater heat flow dissipation, is oriented on the sides of the mold

with the thermally and mechanically stressed areas of the mold (page 4, lines 2-26; page 5, lines 1-5; page 6, lines 24-26; and Figures 2-4). The liquid-cooled chill mold (casting die) includes a cavity that is composed of two broad-side walls and narrow-side walls delimiting the width of the slab, or billet (page 6, lines 2-16). The cross-section of the mold at the pouring-in-side end is greater than at the billet-exit-side end, or of a descending funnel shape with a hollow cavity becoming smaller in the pouring direction (page 4, lines 6-8; and Figure 1). Stagge et al. do not specifically teach a surface-related heat flow in the more stressed area of the bath surface that is 5-40% (or 10-20%) greater than in the other areas of the bath surface.

However, Hargassner et al. teach a variable heat transmission coefficient (alpha) between the internal plate and the coolant with values ranging between 20 and 70 kW/m^2K, preferably between 25 and 50 kW/m^2K (column 1, lines 51-59). The heat transmission coefficient is dependent on the coolant flow velocity and the width of the coolant ribs (column 3, lines 36-45 and 66-68; column 4, lines 1-17 and 55-61; the table in column 4; and Figures 5-8). These variables are optimized for the purpose of producing effective cooling of the internal casting mold plates (column 1, lines 37-50). One of ordinary skill in the art would have recognized the optimum values of coolant flow velocity would directly related to controlling the heat transmission coefficient ranging between 20 and 70 kW/m^2K (ranging up to a factor of 3.5), which would entirely include the variations of 5-40% disclosed herein. Discovery of optimum values of resulting effective variables in a known process is within the level of ordinary skill in the art. In re Boesch and Slaney, 205 USPQ 215 (1980).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the liquid-cooled chill mold (casting die) of Stagge et al. by providing the range of values of heat transmission coefficients, channel widths, and flow velocities (Figures 5 and 8) of Hargassner et al. to calculate the surface-related heat flow for improving cooling efficiency of the mold plates (Hargassner et al.; column 1, lines 37-50).

8. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Villanueva et al. (US 5,797,444) or Stagge et al. (WO97/43063) in view of Hargassner et al. (US 5,117,895) as applied to claim 1 above, and further in view of Klein et al. (US 5,095,970).

Either Villanueva et al. or Stagge et al. (each in view of Hargassner et al.) discloses all the elements of claim 1 above. Neither Villanueva et al. nor Stagge et al. (each in view of Hargassner et al.) specifically teaches the cooling zone extending at least 20% (or 30-60%) of the length of the meniscus of the broad-side wall.

However, Klein et al. teach a cooling device along the height of the wide side of the mold cavity that extends approximately 55-75% of the height of the wide sides of the walls (column 1, lines 29-34; column 2, lines 67-68; column 3, lines 1-4; and Figures 1-4) for the purpose of uniform cooling of the metal strand product (column 1, lines 24-26).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the liquid-cooled casting mold assemblies of either Villanueva et al. or Stagge et al. (each in view of Hargassner et al.) by adding the

quantitatively specified cooling device of Klein et al. in order to obtain uniform cooling of the product (Klein et al.; column 1, lines 24-26).

9. Claims 12, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Villanueva et al. (US 5,797,444) or Stagge et al. (WO97/43063) in view of Hargassner et al. (US 5,117,895) as applied to claim 1 above, and further in view of Nakashima et al. (US 5,207,266).

Either Villanueva et al. or Stagge et al. (each in view of Hargassner et al.) discloses all the elements of claim 1 above. Neither Villanueva et al. nor Stagge et al. (each in view of Hargassner et al.) specifically teaches narrower configured coolant channels or cooling bore holes running parallel to the pouring direction with spacings of at least 20% less than in the horizontal adjoining areas of the bath surface in the transition area.

However, Nakashima et al. teach narrower configured coolant channels with regard to their spacings and widths (column 1, lines 47-61; column 4, lines 33-63; and Figures 2, 9, 11-13, and 16). These coolant channels are arranged in a parallel fashion in the thermally stressed area of the mold wall, as shown by the temperature gradients (Figures 11-13 and 16). The spacing of the coolant channels (as defined by the widths w, 1.5w, and W) are at least 20% less than the horizontal adjoining area(s) of the surface in the transition (cooling) area(s) (Figures 2, 13 and 16). Additional coolant channels (bore holes) of varying widths and angles are situated between the surface

coolant channels (Figure 9). The increased number of coolant channels is desired for the purpose of obtaining a more uniform cooling effect (column 1, lines 39-46).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the liquid-cooled casting mold assemblies of either Villanueva et al. or Stagge et al. (each in view of Hargassner et al.) with cooling channels of various spacings and widths taught by Nakashima et al. in order to achieve a more uniform cooling effect (Nakashima et al.; column 1, lines 39-46).

Response to Arguments

10. The examiner acknowledges with appreciation the applicants' amendment (paper #13) sent by facsimile on December 12, 2001, since the original copy of the amendment (mailed by the applicants on November 5, 2001 with a two-month extension of time), did not arrive at the USPTO during that time span due to mailing difficulties. The applicants' amendment has successfully been amended to overcome the objections to the specification and claims (with the exception of a remaining objection to claim 1), as well as the rejections under 35 USC 112, 2nd paragraph, 35 USC 102(e), and 35 USC 102(a). Following the applicants' cancellation of claims 8 and 13 (and subsequent incorporation of those claims into claims 1 and 12, respectively), claims 1-7, 9-12, 14, and 15 remain; however, these pending claims are rejected based on the abovementioned grounds of rejection under 35 USC 103(a).

11. Applicant's arguments filed December 12, 2001, have been fully considered but they are not persuasive.

With regard to the Stagge et al. reference, it is noted that the liquid-cooled (copper) mold of Stagge et al. is funnel-shaped and contains areas that are more susceptible to heat and mechanical stresses than in other areas of the mold. This is in contrast to the applicant's argument that there exist no such stressed areas for which enhanced cooling is provided in the liquid-cooled mold of Stagge et al. Critically high thermal and mechanical stresses especially exist at the bath level (meniscus region), for which Stagge et al. preferentially arranges a multiplicity of cooling bores. As a result, an increased cooling rate necessarily exists at and near the bath level with respect to other areas of the mold. Along the same lines, the Villanueva et al. and Grove et al. references both teach cooling-optimized areas constituting a region having elevated heat transfer coefficients (enhanced heat transfer regions and differentials). The Hargassner et al. reference remedies the lack of quantitative limitations in the Stagge et al., Villanueva et al., and Grove et al. references (see above 35 USC 103(a) rejections).

With regard to prior rejections of claims 6 and 7, the applicant has argued against the teachings of either Villanueva et al. or Stagge et al. in combination with Klein et al. However, a differential cooling zone is present in all references, in addition to the quantitative measures in the newly combined Hargassner et al. reference, as necessitated by the applicants' amendment. Therefore, it would have been obvious to one of ordinary skill in the art to have combined either the Villanueva et al. or the Stagge et al. reference (in view of the Hargassner et al. quantitative cooling zone

differentials) and the Klein et al. cooling device along the height of the wide side of the mold cavity that extends approximately 55-75% of the height of the wide sides of the walls in order to obtain uniform cooling of the product. A meniscus region inherently exists in all continuous casting molds during operation, and would serve as the solid/liquid metal interface (extending to a solidification point) reaching sufficiently downward into the mold to form a region that would readily be recognized as the most critically stressed area within the mold. One of ordinary skill in the art would recognize that cooling is most needed in those interface regions. The Grove et al. reference also teaches this feature, but is now combined with Hargassner et al. due to its absence of quantitative properties.

Hargassner et al. (used as the new secondary reference for independent claim 1) state that the coolant speed maintains the heat transmission coefficient between a range of 20 and 70 kW/m^{2}K. Figure 5 of Hargassner et al. shows the plot of alpha versus rib width, showing the wide variability of flow control and cooling intensity. The examiner respectfully asserts that these variables would be optimized for the purpose of producing effective cooling of the internal casting mold plates, and would furthermore be recognized by one of ordinary skill in the art, as viewed on the basis of the teachings of any one of Grove et al., Villanueva et al., or Stagge et al., since the liquid-cooled molding apparatuses in each of these references contain heat flow differentials. One of ordinary skill in the art would have recognized the optimum values of coolant flow velocity would be directly related to controlling the heat transmission coefficient ranging between 20 and 70 kW/m^{2}K (ranging up to a factor of 3.5), which would entirely include

the variations of 5-40% disclosed in amended claim 1. Furthermore, discovery of optimum values of resulting effective variables in a known process is within the level of ordinary skill in the art. In re Boesch and Slaney, 205 USPQ 215 (1980).

Claims 12, 14, and 15 are now rejected under either Villanueva et al. or Stagge et al. (in view of Hargassner et al.), and further in view of Nakashima et al. The arguments presented against the content of the Nakashima et al. reference in the applicant's amendment relate to the channel spacing, with the applicant citing Figure 14, which appears to have similar spacing, and was not used as an example in the prior office action of June 6, 2001. Figures 2, 9, 11-13, and 16 clearly show that Nakashima et al. include cooling channels of differing spacings and widths, for which the (heat flow differential) teachings of either Villanueva et al. or Stagge et al. provide the basis for a proper obviousness combination with Nakashima et al., as the varying coolant channels would facilitate cooling in the more stressed regions of the mold.

Claims 1-7, 9-12, 14, and 15 (all pending claims) are rejected for both new and prior reasons presented above.

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin P. Kerns whose telephone number is (703) 305-3472. The examiner can normally be reached on Monday-Friday from 8:00am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Dunn can be reached on (703) 308-3318. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 305-7718 for regular communications and (703) 305-6078 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

KPK
kpk
January 15, 2002

M. ALEXANDRA ELVE
PRIMARY EXAMINER